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THE TWENTIETH CENTURY ENGINEER[1]

It is essential to develop industrialism, . . . to train men so that they shall be engineers, merchants—in short, men able to take the lead in all the various functions indispensable in a great modern civilized state.

Such was the recent utterance of a distinguished American traveler in an address at the ancient Moslem University on the banks of the Nile. It reflects the sentiment prevailing in America to-day. Mr. Roosevelt held up as it were a mirror to the Egyptians, that they might see in it the reflection of American conviction relative to education. The underlying thought is, as he expressed it, that

There has always been too great a tendency in the higher schools of learning in the west (the occident) to train men merely for literary, professional and official positions; altogether too great a tendency to act as if a literary education were the only real education.

The foundation of healthy life in the state is necessarily composed of the men who do the actual productive work of the country. Among these producers the engineer is preeminent. Without him in the complex commercial life of the present, capital would lie idle, colossal manufactures would shrink to individual industries, the development of resources would cease, the earth would no longer contribute as now to the wealth of nations, and society might eventually relapse into the relation of the feudal baron and his retainers of the middle ages.

The engineer is now more than ever before an essential factor in affairs. Engi-

[1] An address delivered at the dedication of Pasadena Hall of the Throop Polytechnic Institute, Pasadena, Cal., June 8, 1910.

neering information and technical skill are in demand in many fields not heretofore requiring them. What manner of man is this present-day engineer, whose existence and work are so vital to the higher interests of society? What are the intellectual qualities that fit him for his high office, what the aptitudes that qualify him for leadership, what the supreme test of his fitness to bear on his shoulders some of the burdens of organized civil life and to lead the way toward still higher achievements? Finally, what style of intellectual training is best suited to fit him for the prodigious problems awaiting solution at his hands?

It is not necessary, even in this presence, to refrain from saying that the type of man, whom we are about to survey in his highest ethical and intellectual character, is not an artisan, a motorman, nor even an engine-driver, as useful and honorable as these callings are. Nor is it manual training or manual dexterity or mechanical skill that constitutes his claim to recognition as an invaluable contributor to progress in the twentieth century. He is rather the masterful man who unites oceans and revises the paths of commerce; who levels hills and removes mountains if they chance to be in his way; who changes the course of rivers or sends them through tunnels to generate electric light and power and to convert deserts into fruitful fields.

If modern industry demands combination and the massing of capital, combination requires the services of large-minded engineers as managers. When Cecil Rhodes appealed to the Rothschilds for capital to form the De Beers Diamond Mining Company for the purpose of uniting all the diverse and independent claims of the Kimberley diamond field, he was assured that money would be furnished on condition that they be permitted to place in charge their mining engineer as manager—Mr. Gardner Williams, who hailed from the great state of the Golden Gate. Mr. Williams substituted for the open working of the diamond mines his method of mining by vertical shafts, and horizontal tunnels into the core of the precious "blue ground" filling the volcanic pipes, which have yielded uncut diamonds to the aggregate value of more than $500,000,000.

When the great gold-bearing reef at Johannesburg, the richest gold mining district in the world, needed a controling genius to direct the Kaffir mines, it was John Hays Hammond, another American mining engineer, who dictated the engineering and mining policies of the Witwatersrand. Hammond adapted the method of mining the ore and winning the precious metal to the conditions existing in that great outcropping reef, forty miles in length, with the result that a low-grade conglomerate has yielded millions of gold with a fair profit to the shareholders. In large enterprises of this character success or failure turns on the trained intellect, the executive ability, and the comprehensive grasp of the controlling brain at the head.

There is no rainfall in Egypt. The burning, wind-driven sands forever face a cloudless sky. On half the city of Cairo no green thing grows and flourishes. Mosques and the splendid tombs of the Memlook sultans are surrounded by drifting sand. But for the yellow flood of Father Nile the whole of its fertile valley would be as parched as the sands about the great pyramids of El-Geezeh. I have seen the river in flood, when its turbid water stretched for miles beyond its banks to the rising ground at the feet of the Sphinx, enriching, irrigating and insuring a bountiful harvest to the stolid husbandman, who still practises the methods consecrated by

centuries of use. Nature has done much for Egypt; engineering has done no less. The *barrage* at Cairo and the stupendous dam at Assûan conserve the rich tepid flood of the Nile and pour it in golden streams over a million acres of fertile sugar-cane and cotton land. Instead of a burning, barren waste, the land of the Pharaohs has become more than ever before in history a garden of the gods. Egypt may hate England, but to Sir Colin Scott-Moncrieff, an English engineer, who raised the *barrage* at Cairo and built the Assûan dam, she owes more than she ever did in ancient times to Rameses II.

Across the Firth of Forth in Scotland stretches a massive iron bridge with two main cantilever spans, each longer than the famous Brooklyn bridge. They were pushed out horizontally from two cantilever shore arms without scaffolding or false works, and with the roadbed soaring 300 feet above the water of the Firth. M. Eiffel declared that it was in comparison an easy task to build the Eiffel tower nearly 1,000 feet high, because it is vertical and stands on a firm base; but to push out such a tower horizontally 300 feet above an arm of the sea, and to balance it during construction on the top of a tall pier, was infinitely more difficult and hazardous. This hazardous feat the late Sir Benjamin Baker accomplished, and over his monumental bridge 400 or 500 trains now pass daily. It was this same plain but resourceful engineer who designed the cylindrical ship that transported Cleopatra's needle from Alexandria to New York.

These daring, resourceful and intrepid engineers are examples of those who did their work for the most part in the last century. They are typical of a class who achieved fame and accomplished great things with but little help from the universities. They learned their lessons in the great school of experience, and arrived at success despite the lack of the early opportunities now open to the aspiring engineering student. They were not narrow specialists, but men with the broad intelligence to consider a new and difficult problem from all points of view, and to employ for its solution any method which their intellectual resources could command. They were not mere copyists, who read nothing beyond the headlines of their copybooks, nor yet mere imitators content to cull from the products of genius those that could be adapted to the problems in hand. They were rather the creators, whose edifices, built on the foundation stones hewn by others, have risen above the horizon for many lands.

If we inquire somewhat more minutely into the qualities that make for leadership in engineering, we shall find that thoroughness, originality and the habit of making all mental acquirements one's own are essential. Originality is a gift, but it may be cultivated; the two other qualities are certainly within the reach of every young man with normal mental endowments. The habit of going to the bottom of every subject investigated instead of contentment with a superficial examination is one to be assiduously cultivated. Each essay in concentrated effort makes mental fitness for still deeper levels of penetration.

Thoroughness is associated with sincerity in the conduct of public works. The greater undertakings which an engineer is called on to design and execute are not the ephemeral structures, made of "staff" and designed to house an international exhibition; they are for posterity as well as for his contemporaries. Noble examples of thorough and sincere work have come down to us from ancient times. One allows the eye to follow with admiration the long lines of aqueduct stretching across the

Roman Campagna, in large part still standing, though gnawed for centuries by the tooth of time. In the Forum in Rome is an opening into which one may descend to the uncovered Cloaca Maxima, or great drain of the imperial city. It was built long before the Christian era and was old when Paul suffered imprisonment in Rome and execution outside the gates. Huge rectangular blocks of tufa lie in perfectly level courses without cement, and through this great drain to-day runs a stream, like a small river, on its way to the yellow Tiber. This was honest work and the twentieth century engineer might well imitate it.

Then the proper assimilation of one's information is no less essential than thoroughness. It is not uncommon to observe a sort of aloofness of a man's mental attainments with respect to his powers of practical achievement. He appears to have put his acquisitions in a safety vault and lost the key. His intellectual equipment is for adornment and not for use. His collection resembles some collections of physical and engineering apparatus I have seen, well arranged from the point of view of a museum, but never used. A certain college janitor once complained in explanation of his ill health that his food didn't "suggest." This state of health is characteristic of the mental dyspeptic, who does not digest his intellectual pabulum, nor does it "suggest" any way in which it may be turned to good account.

Another quality of the great engineer is daring. The mythical Darius Green had it, but his daring was not coupled with the propelling power of an internal combustion engine; hence his story only adorns a rhythmic tale. His flying machine was not a forerunner of the aeroplane. Without this quality of daring developed to an astonishing degree the Wrights would not have amazed the world by their sustained flights, Bleriot would not have soared aloft across the English Channel, Paulhan would not have flitted from London to Manchester, nor would Curtiss have followed the silver line of the noble Hudson from Albany to New York. These men are representative enthusiasts of the aeroplane, whose intrepidity has made possible the navigation of the air.

The history of the first Hudson River tunnel at New York is one of repeated accidents, of many failures and of final success. During one of the periods of inactivity and when the enterprise halted near complete failure, Sir Benjamin Baker was brought over from England as a consulting engineer to give advice to the company. The air caissons were in a dangerous leaky condition, but Sir Benjamin must himself go down to make an examination. So he called for a volunteer to accompany him. An Irish laborer stepped forward and indicated his willingness to go. Together the two descended into the pneumatic caisson. The inspection completed, imagine their dilemma when Sir Benjamin discovered that their return was cut off by the leaky condition of the air locks. The eminent engineer said to his Irish companion that there was only one thing to do; they must bring mud in their caps, plaster over the cracks, and stop the leaks. The expedient was happily successful and the two escaped into the upper air. I heard Sir Benjamin tell the story to illustrate the devotion of the Irish laborer. After they were safely out Sir Benjamin said to his companion in danger, "Pat, why did you risk your life to go down into the caisson with me?" Pat replied, "I'll tell you, sir. Do you remember when you were building the Forth bridge and the foundation of one of the piers was going in, and you were in the pit inspecting the

work, that Mike McGinnis, Dan O'Leary and myself were dumping stone into that same pit, and dumped a load without seeing that you were below? But as good luck would have it, sir, you were not hit. And what did you do, sir? You just turned an eye up to see who had dumped the stone, but you said nothing, sir, and we were not told to go to the office for our time. And now here I am, sir; I endangered your life once, and it was only fair for me to take a risk for you when you needed it." Ah! how many unrecorded deeds of devotion stand to the credit of the common laborers, who have risked their lives, and, alas, too often lost them, in carrying out some great enterprise for the public. The engineer at the head must be the intrepid leader of intrepid men.

The engineer who devises and executes public undertakings of magnitude must always be prepared for the unexpected and therefore must be resourceful. It is not unusual to encounter difficulties not anticipated. These must be surmounted or failure is inevitable. A solution must be found without delay or great interests are imperiled. Swiss engineers are at present constructing a short-cut railway line between Lake Thun and the mouth of the Simplon tunnel. It includes a long tunnel through a mountain range. Two years ago, after this had been driven forward about a third of the whole length from either end, the cut from the south side was unexpectedly and suddenly driven into a deep cleft or fault filled with soft mud and ooze and forming the underlying filled bed of a mountain stream. Twenty-five men were overwhelmed and lost their lives. Now a tunnel could doubtless be pushed through soft material of this nature, but there was no foundation on which it might rest. Was the enterprise therefore abandoned? By no means. Starting back a short distance from the uncovered fault, the engineers ran a curve into the heart of the mountain behind the obstruction; this will join the two straight portions already completed.

A similar fault 900 feet deep and filled with sediment has been found under the bed of the Hudson at the Highlands, where the new aqueduct crosses the river. Since this is an aqueduct and not a viaduct, a different solution is possible. The tunnel is to be carried under the river as an inverted siphon with the vertical legs nearly 1,000 feet deep. If one can not remove or overcome an obstacle, one may at least go around or under it.

These enumerated qualities which make an engineer fit are intellectual. There is still another which is a supreme test of fitness for public service. It is the moral quality of honesty. Failing in this, there is no compensation. Intellectual honesty includes the characteristic of sincerity, to which allusion has already been made. Moral honesty is no less essential in any age, but especially so in these days of uncovered bribery and graft. The honest engineer's opinions are not for sale to the highest bidder. He is entitled to compensation for his judgment and his decisions, but they can not be purchased, a distinction with a marked difference.

There has never been an age when capable and honest engineering talent was more in demand than in this new century. The present-day problems in great cities, incident to the rapid introduction of new methods of transportation, of lighting and power, and of communication, are insistent for solution. They are almost hopelessly entangled with vested rights, and with class privileges, which have been recklessly given away in the past, or handed over for a secret and vicious consideration on the part of those incidentally in power. Civic

bodies and public-service commissions, thanks to such heroic leaders as Governor Hughes, are now giving expert attention to the solution of these economic problems in cities, aided by the highest engineering talent that good compensation can command. New York, Chicago and now Pittsburg are the subjects of study by such commissions, constituted either by private appointment or by legislative enactment. The engineers studying these problems must be clean-handed and honest to the core. This kind of public service is in its infancy, and the future is certain to furnish more of it for competent and clean engineers.

I have sketched rapidly the salient characteristics of the modern engineer required for the larger problems of an age in which industrial development proceeds with astounding rapidity. It is too much to expect these qualities to be displayed in a marked degree by young men just entering upon a course of study leading to a degree in engineering. It is not the mere possession of such qualities that ensures success, but the marked development of them. There are boys enough of sterling character, with originality, thoroughness, nerve and resourcefulness in the directions in which the interests of youth lie. It is the office of the enthusiastic teacher to develop the possibilities of a promising boy, to stimulate the growth of those traits that especially need nurture, and to encourage the power of initiative and self-reliance. And he shall have his reward. It comes not in the way of pecuniary compensation, but in that sweeter award of appreciation and gratitude on the part of those whose regard in after years counts for more than mere passing popularity. No greater delight comes to the worthy teacher of large experience than the success of those in whom he has taken a personal interest, and for whom he has been able to open the door of opportunity.

It is pertinent now to touch on the style of training best adapted to develop the qualities that distinguish the eminent engineer from his less fortunate fellows. What shall be the philosophy of his treatment educationally for the conservation of his undeveloped resources and the reclamation of his arid areas? These are serious issues for thousands of ambitious students who stand on the threshold of their young manhood.

The recent trend of affairs has shown too pronounced a tendency toward undue specialization in engineering practise. It is not enough that instead of the two traditional divisions of engineers in olden times, the civil and the military, there are now in practise civil, mechanical, mining, hydraulic, electrical, telegraph, telephone, sanitary, chemical, electrochemical and illuminating engineers, but the enthusiasts in these several lines are insisting that their specialties be assigned a seat in the circle of the engineering curriculum. This granted, the young collegian has either a narrow training that reduces him to the grade of an artisan, or the instruction given him is so superficial that it never strikes root and never reaches down to stir his subconscious powers. It may be sufficient for the practised eye of a Paulhan to get a vivid impression of the salient features of a landscape from the window of a railway carriage to serve as a guide in an aerial flight over the same region; but the young engineer, who gets a flitting view of the whole field of current engineering practise from the moving-picture show of a lecture-room lantern screen will have only a sorry preparation for sustained flight when he attempts to rise by the power of his own enginery.

Instead of a panoramic view of engineer-

ing practise, an interested public has the right to demand training in fundamentals and the elimination of ephemeral details that constitute a current art and not a body of permanent principles. The older culture course has its humanistic studies, consecrated by centuries of use, and a body of trained experts as teachers, who are not often drafted from institutions of learning by the superior rewards of professional life. Pure science also has its settled subjects of study—its languages, its higher mathematics and its circle of related sciences. Then too the scientific worker who has insight and becomes a discoverer enjoys a superlative satisfaction denied to men who never add to the sum of human knowledge as the results of research.

In contrast with these old-established courses, those in engineering are still indeterminate and lack a certain coherence which is the product of age. Shop work has too often been exalted above language, and laboratories have been established in imitation of a factory or a central power station. The fundamentals for general culture have been pushed aside by the onrush of machinery, and a young graduate must be able to run a steam engine and take an indicator card, even though he can not write a straight English sentence or dictate a business letter worthy to go on a post card.

Too much stress can hardly be placed on the necessity of thorough instruction in English. It is a common impression among the young that the study of one's mother tongue is a waste of time. There never was a greater fallacy. Psychologists tell us that a speech center has to be formed and developed in the brain. So far is human speech from being intuitive and automatic that we acquire it only by continuous and incessant effort. There is no tool used by the human mind requiring more polishing and taking a finer finish. Language is not an inheritance, but an acquisition. It may resemble on the one hand the crude spears or assegai of the South African Kaffirs, or on the other the flexible incisiveness of a polished Damascus blade. American college students have less facility in the use of idiomatic English than have students of the same age in the English universities. When one listens to the limpid and expressive English of an Oxford senior, and notes his large vocabulary and his facile use of it, as compared with the senior in an American college, one is prepared to admit the propriety of the distinction often drawn on the continent between English and American.

The engineering student should have sufficient acquaintance with the best masterpieces in English to give him a taste for the highest types of English prose, and enough practise in writing themes to secure for himself a clear and expressive style of composition.

The opinion of eminent engineers on the pressing need of a better use of English on the part of members of their profession is the best evidence of the neglect of instruction in English in engineering courses in the past. The acquisition of a clear, terse style is urged by them on the ground that an important feature of the modern engineer's duties is to make reports on various phases of engineering undertakings. These reports are an index of the man, and if they are defective in form or finish, the natural conclusion is that he is also deficient as an engineer.

It is scarcely necessary to insist on thorough courses in physics and mathematics as fundamental subjects for all engineers, though the former has often been pushed aside, with barely time enough for instruction in the merest elements of the subject, notwithstanding the fact that engineering

is largely applied physics. A civil engineer at the head of that department in a large technical school recently admitted that engineering students should take a course in light because of their use of optical instruments in surveys and locations, but he expressed the opinion that they had no use for the study of sound. And yet the abatement of serious and unnecessary noises in large cities is already the avowed object of several voluntary organizations. Any observant traveler, who has occasion to patronize the New York subways, will readily admit that some attention to the avoidance of noise on the part of the civil engineers who designed the subways would have been of great benefit to the patrons of that wonderful artery of travel. When the London Central was first put in service seventy-five feet below the surface, complaints and suits at law were numerous on the ground of serious vibrations transmitted to buildings overhead. These vibrations have largely been eliminated by reconstructing the electric engines to prevent their pounding the rails. Such facts as these the modern engineer would do well to heed.

An engineering course should include instruction in history and economics. The great civic and economic facts of the larger world should be a part of the engineer's outfit. His part in the world's work has close connection with those social and economic movements that are conditioned on future development; and the only guide we have for the future is the teaching of the past.

If present courses in engineering are to conform to these suggestions, some modifications in the purely technical subjects are requisite. Instruction in these may well be confined more closely to fundamental principles and to the enforcement of them by the concrete examples furnished by the exercises in the laboratory. A multitude of details do not belong in the instruction given to immature students, but to the actual work of the practising engineer. If inquiry is made of the experienced engineer from whom he got the most help in his college course, he will not mention the teacher whose instruction consisted largely of a category of details of the engineering art, but rather the one who marshaled the leading facts of the subject under general principles, brought out clearly the correlation between them, and enforced them by the work of the laboratory, which had obvious and vital connection with the instruction of the class-room.

My friends, I have seen young men develop into engineers who are now engaged in leading work in the world. They are directing large operations in telephone companies, holding influential posts in electric light and power industries, directing new enterprises destined to develop resources, superintending manufactures of large moment, and supervising construction undertaken by the Reclamation Service of the federal government. Such men as these give me great hope for the future of this institute planted in the most attractive spot in the empire of California south of the Tehachepi. This is a region abounding in undeveloped possibilities. Its water powers, its mines, its reservoirs of liquid fuel, its irrigation possibilities, coupled with a soil in which nature has been lavish in her gifts of productiveness, and its ocean shore in touch with the wealth of the orient, all combine to offer a field to the aspiring engineer unsurpassed in history and written all over with fetching inducements to noblest effort.

The young man who wishes to become a component part of this empire as an engineer will enter this institute and take a straight course, looking for no short cuts

to a degree, expecting no magician to lift him over hard work, and later to put him down softly in easy engineering positions. To all such the Throop Polytechnic Institute says, "Come this way!"

HENRY S. CARHART

MEDICAL EDUCATION IN THE UNITED STATES AND CANADA[1]

THE necessity of a reconstruction that will at once reduce the number and improve the output of medical schools may now be taken as demonstrated. A considerable sloughing off has already occurred. It would have gone further but for the action of colleges and universities which have by affiliation obstructed nature's own effort at readjustment. Affiliation is now in the air. Medical schools that have either ceased to prosper, or that have become sensitive to the imputation of proprietary status or commercial motive, seek to secure their future or to escape their past by contracting an academic alliance. The present chapter undertakes to work out a schematic reconstruction which may suggest a feasible course for the future. It is not supposed that violent measures will at once be taken to reconstitute the situation on the basis here worked out. A solution so entirely suggested by impersonal considerations may indeed never be reached. But legislators and educators alike may be assisted by a theoretical solution to which, as specific problems arise, they may refer.

This solution deals only with the present and the near future—a generation, at most. In the course of the next thirty years needs will develop of which we here take no account. As we can not foretell them, we shall not endeavor to meet them. Certain it is that they will be most effectively handled if they crop up freely in an unencumbered field. It is therefore highly undesirable that superfluous schools now existing should be perpetuated in order that a subsequent generation may find a means of producing its doctors provided in advance. The cost of prolonging life through this intervening period will be worse than wasted; and an adequate provision at that moment will be embarrassed by inheritance and tradition. Let the new foundations of that distant epoch enjoy the advantage of the Johns Hopkins, starting without handicap at the level of the best knowledge of its day.

The principles upon which reconstruction would proceed have been established in the course of this report: (1) a medical school is properly a university department; it is most favorably located in a large city, where the problem of procuring clinical material, at once abundant and various, practically solves itself. Hence those universities that have been located in cities can most advantageously develop medical schools. (2) Unfortunately, however, our universities have not always been so placed. They began in many instances as colleges or something less. Here a supposed solicitude for youth suggested an out-of-the-way location; elsewhere political bargaining brought about the same result. The state universities of the south and west, most likely to enjoy sufficient incomes, are often unfortunately located: witness the University of Alabama at Tuscaloosa, of Georgia at Athens, of Mississippi at Oxford, of Missouri at Columbia, of Arkansas at Fayetteville, of Kansas at Lawrence, of South Dakota at Vermilion; and that experience has taught us nothing is proved by the recent location of the State University of Oklahoma at Norman. Some of these institutions are freed from the necessity of undertaking to teach medicine by an endowed institution better situ-

[1] From the Report to the Carnegie Foundation for the Advancement of Teaching by Abraham Flexner.

ated; in other sections the only universities fitted by their large support and their assured scientific ideals to maintain schools of medicine are handicapped by inferiority of location. We are not thereby justified in surrendering the university principle. Experience, our own or that of Germany, proves, as we have already pointed out, that the difficulty is not insuperable. At relatively greater expense, it is still feasible to develop a medical school in such an environment: there is no magnet like reputation; nothing travels faster than the fame of a great healer; distance is an obstacle readily overcome by those who seek health. The poor as well as the rich find their way to shrines and healing springs. The faculty of medicine in these schools may even turn the defect of situation to good account; for, freed from distraction, the medical schools at Iowa City and Ann Arbor may the more readily cultivate clinical science. An alternative may indeed be tried in the shape of a remote department. The problem in that case is to make university control real, to impregnate the distant school with genuine university spirit. The difficulty of the task may well deter those whose resources are scanty or who are under no necessity of engaging in medical teaching. As we need many universities and but few medical schools, a long-distance connection is justified only where there is no local university qualified to assume responsibility. A third solution—division—may, if the position taken in previous chapters is sound, be disregarded in the final disposition.[2]

(3) We shall assign only one school to a single town. As a matter of fact, no American city now contains more than one well-supported university[3]—and if we find it unnecessary or impolitic to duplicate local university plants, it is still less necessary to duplicate medical schools. The needless expense, the inevitable shrinkage of the student body, the difficulty of recruiting more than one faculty, the disturbance due to competition for hospital services, argue against local duplication. It is sometimes contended that competition is stimulating: Tufts claims to have waked up Harvard; the second Little Rock school did undoubtedly move the first to spend several hundred dollars on desks and apparatus. But competition may also be demoralizing; the necessity of finding students constitutes medical schools which ought to elevate standards the main obstacles to their elevation: witness the attitude of several institutions in Boston, New York, Philadelphia, Baltimore and Chicago. Moreover, local competition is a stimulus far inferior to the general scientific competition to which all well equipped, well conducted and rightly inspired university departments throughout the civilized world are parties. The English have experimented with both forms —a single school in the large provincial towns, a dozen or more in London—and their experience inclines them to reduce as far as possible the number of the London schools. Amalgamation has already taken place in certain American towns: the several schools of Cincinnati, of Indianapolis and of Louisville have all recently "merged." This step is easy enough in towns where there is either no university or only one university. Where there are several, as in Chicago, Boston and New York, the problem is more difficult. Approached in a broad spirit it may, however, prove not insoluble; cooperation may be arranged where several institutions all

[2] We shall omit the half-school because it may be considered to divide with the whole school the work of the first two years; it does not greatly affect the clinical output, with which this chapter is mainly concerned.

[3] Chicago is almost an exception, as Northwestern University is situated at Evanston, a suburb.

possess substantial resources; universities of limited means can retire without loss of prestige—on the contrary, the respect in which they are held must be heightened by any action dictated by conscientious refusal to continue a work that they are in no position to do well.

(4) A reconstruction of medical education can not ignore the patent fact that students tend to study medicine in their own states, certainly in their own sections. In general, therefore, arrangements ought to be made, as far as conditions heretofore mentioned permit, to provide the requisite facilities within each of the characteristic state groups. There is the added advantage that local conditions are thus heeded and that the general profession is at a variety of points penetrated by educative influences. New Orleans, for example, would cultivate tropical medicine; Pittsburgh, the occupational diseases common in its environment. In respect to output, we may once more fairly take existing conditions into account. We are not called on to provide schools enough to keep up the present ratio. As we should in any case hardly be embarrassed for almost a generation in the matter of supply, we shall do well to produce no doctors who do not represent an improvement upon the present average.

The principles above stated have been entirely disregarded in America. Medical schools have been established regardless of need, regardless of the proximity of competent universities, regardless of favoring local conditions. An expression of surprise at finding an irrelevant and superfluous school usually elicits the reply that the town, being a "gateway" or a "center," must of course harbor a "medical college." It is not always easy to distinguish "gateway" and "center"; a center appears to be a town possessing, or within easy reach of, say 50,000 persons; a gateway is a town with at least two railway stations. The same place may be both—in which event the argument is presumably irrefragable. Augusta, Georgia, Charlotte, N. C., and Topeka, Kans., are "centers," and as such are logical abodes of medical instruction. Little Rock, St. Joseph, Memphis, Toledo, Buffalo, are "gateways." The argument, so dear to local pride, can best be refuted by being pursued to its logical conclusion. For there are still forty-eight towns in the United States with over 50,000 population each, and no medical schools: we are threatened with forty-eight new schools at once, if the contention is correct. The truth is that the fundamental, though of course not sole, consideration is the university, provided its resources are adequate; and we have fortunately enough strong universities, properly distributed, to satisfy every present need without serious sacrifice of sound principle. The German Empire contains eighty-four cities whose population exceeds 50,000 each. Of its twenty-two medical schools, only eleven are to be found in them: that is, it possesses seventy-three gateways and centers without universities or medical schools. The remaining eleven schools are located in towns of less than 50,000 inhabitants, a university town of 30,000 being a fitter abode for medical study than a non-university town of half a million, in the judgment of those who have best succeeded with it.

That the existing system came about without reference to what the country needed or what was best for it may be easily demonstrated. Between 1904 and 1909 the country gained certainly upwards of 5,000,000 in population; during the same period the number of medical students actually decreased from 28,142 to 22,145, *i. e.*, over 20 per cent. The average

annual production of doctors from 1900 to 1909 was 5,222; but last June the number dropped to 4,442. Finally, the total number of medical colleges which reached its maximum—166[4]—in 1904 has in the five years since decreased about 10 per cent. Our problem is to calculate how far tendencies already observable may be carried without harm.

We have calculated that the south requires for the next generation 490 new doctors annually, the rest of the country, 1,500. We must then provide machinery for the training of about 2,000 graduates in medicine yearly. Reckoning fatalities of all kinds at ten per cent. per annum, graduating classes of 2,000 imply approximately junior classes of 2,200, sophomore classes of 2,440, freshman classes aggregating 2,700—something over 9,000 students of medicine. Thirty medical schools, with an average enrollment of 300 and average graduation classes of less than 70, will be easily equal to the task. As many of these could double both enrollment and output without danger, a provision planned to meet present needs is equally sufficient for our growth for years to come. It will be time to devise more schools when the productive limit of those now suggested shall come in sight.

For the purpose here in mind, the country may be conceived as divided into several sections, within each of which, with due regard to what it now contains, medical schools enough to satisfy its needs must be provided. Pending the fuller development of the states west of the Mississippi, the section east will have to relieve them of part of their responsibility. The provisional nature of our suggestions is thus obvious; for as the west increases in population, as its universities grow in number and strength, the balance will right itself: additional schools will be created in the west and south rather than in the north and east. It would of course be unfortunate to over-emphasize the importance of state lines. We shall do well to take advantage of every unmistakably favorable opportunity so long as we keep within the public need; and to encourage the freest possible circulation of students throughout the entire country.

1. New England represents a fairly homogeneous region, comprising six states, the population of which is increasingly urban. Its population increased, 1908–9, somewhat less than 75,000, requiring, on the basis of one doctor to every increase of 1,500 in population, 50 new doctors. About 150 physicians died. Seventy-five men would replace one half of these. In all, 125 new doctors would be needed. To produce this number two schools, one of moderate size and one smaller, readily suffice. Fortunately they can be developed without sacrificing any of our criteria. The medical schools of Harvard and Yale are university departments, situated in the midst of ample clinical material, with considerable financial backing now and every prospect of more. It is unwise to divide the Boston field; it is unnecessary to prolong the life of the clinical departments of Dartmouth, Bowdoin and Vermont. They are not likely soon to possess the financial resources needed to develop adequate clinics in their present location; and the time has passed when even excellent didactic instruction can be regarded as compensating for defective opportunities in obstetrics, contagious diseases and general medicine. The historic position of the schools in question counts little as against changed ideals. Dartmouth and Vermont can, however, offer the work of the first two years with the clinical coloring made feasible by the proximity of a hospital, as is the case

[4] Not including osteopathic schools.

with the University of Missouri at Columbia; with that they ought to be content for the time being.

2. The middle Atlantic states comprise for our purpose New York, New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia. Their population grows at the rate of 300,000 annually, for whom 200 doctors can care; 230 more would fill one half the vacancies arising through death: a total of 430 needed. Available universities are situated in New York City, Syracuse, Philadelphia, Pittsburgh, Baltimore. The situation is in every respect ideal; the universities located at New York, Philadelphia and Baltimore are strong and prosperous; those of Syracuse and Pittsburgh, though less developed, give good promise. Without sacrifice of a single detail, these five university towns can not only support medical schools for the section, but also to no small extent relieve less favored spots. The schools of Albany, Buffalo, Brooklyn, Washington,[5] would, on this plan, disappear—certainly until academic institutions of proper caliber had been developed. Whether even in the event of their creation they should for some years endeavor to cultivate medicine is quite doubtful. Appreciation of what is involved in the undertaking might well give them pause. Meanwhile, within the university towns already named there would be much to do: better state laws are needed in order to exterminate the worst schools; merger or liquidation must bring together many of those that still survive. The section under consideration ought indeed to lead the union; but the independent schools of New York and Pennsylvania are powerful enough to prove a stubborn obstacle to any progressive movement, however clearly in the public interest.

3. Greater unevenness must be tolerated in the south;[6] proprietary schools or nominal university departments will doubtless survive longer there than in other parts of the country because of the financial weakness of both endowed and tax-supported institutions. All the more important, therefore, for universities to deal with the subject in a large spirit, avoiding overlapping and duplication. An institution may well be glad to be absolved from responsibilities that some other is better fitted to meet. Tulane and Vanderbilt, for example, are excellently situated in respect to medical education; the former has already a considerable endowment applicable to medicine. The state universities of Louisiana and Tennessee may therefore resign medicine to these endowed institutions, grateful for the opportunity to cultivate other fields. Every added superfluous school weakens the whole by wasting money and scattering the eligible student body. None of the southern state universities, indeed, is wisely placed: Texas has no alternative but a remote department, such as it now supports at Galveston; Georgia will one day develop a university medical school at Atlanta; Alabama, at Birmingham—the university being close by, at Tuscaloosa. The University of Virginia is repeating Ann Arbor at Charlottesville; whether it would do better to operate a remote department at Richmond or Norfolk, the future will determine. Six schools are thus provided:[7] they are sufficient to the needs of the section just now. The resources available even for their support are as yet painfully

[5] Except Howard University, which, patronized by the government, is admirably located for the medical education of the negro.

[6] The south includes eleven states, viz., Virginia, Kentucky, North Carolina, South Carolina, Florida, Georgia, Tennessee, Mississippi, Louisiana, Arkansas, Texas.

[7] A seventh, Meharry, at Nashville, must be included for the medical education of the negro.

inadequate: three of the six are still dependent upon fees for both plant and maintenance. It is doubtful whether the other universities of the south should generally offer even the instruction of the first two years. The scale upon which these two-year departments can be now organized by them is below the minimum of continuous efficiency; they can contribute nothing to science, and their quota of physicians can be better trained in one of the six schools suggested. Concentration in the interest of effectiveness, team work between all institutions working in the cause of southern development, economy as a means of improving the lot of the teacher—these measures, advisable everywhere, are especially urgent in the south.

4. In the north central tier—Ohio, Indiana, Michigan, Wisconsin, Illinois—population increased 239,685 the last year: 160 doctors would care for the increase; 190 more would replace one half of those that died: a total of 350. Large cities with resident universities available for medical education are Cincinnati, Columbus, Cleveland and Chicago. Ann Arbor has demonstrated the ability successfully to combat the disadvantages of a small town. The University of Wisconsin can unquestionably do the same, with a slighter handicap, at Madison whenever it chooses to complete its work there. Indiana University has undertaken the problem of a distant connection at Indianapolis. Four cities thus fulfil all our criteria, two more develop the small town type, one more is an experiment with the remote university department. Surely the territory in question can be supplied by these seven medical centers. Chicago alone is likely to draw a considerable number of students from a wider area. It has long been a populous medical center. Nevertheless the number of high-grade students it just now contains is not large. If the practise of medicine in this area rested on a two-year college basis, as it well might, there would to-day be perhaps 600 students of medicine in that city. Cooperative effort between the two universities there and the state university at Urbana would readily provide for them.

5. The middle west comprises eight states, Minnesota, Iowa, Missouri, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, with a gain in population last year of 216,036, requiring 140 more physicians, plus 160 to replace half the deaths: a total of 300. To supply them, urban universities capable of conducting medical departments of proper type are situated in Minneapolis and St. Louis; and both deserve strong, well supported schools. For Minneapolis must largely carry the weight of the Dakotas and Montana; St. Louis must assist Texas and have an eye to Arkansas, Oklahoma and the southwest. The University of Nebraska, now dispersing its energies through a divided school, can be added to this list; for it will quite certainly either concentrate the department on its own site (Lincoln, population 48,232), or bring the two pieces together at Omaha, only an hour's distance away. The University of Kansas will doubtless combine its divided department at Kansas City. The State University of Iowa emulates Ann Arbor at Iowa City. These five schools must produce 297 doctors annually. Their capacity would go much farther. Oklahoma[8] and the Dakotas might well for a time postpone the entire question, supporting the work of the first two years, which they have already undertaken, on a much more liberal basis than they have yet reached. With the exception of St. Louis,

[8] Should it be possible for the State University of Oklahoma, by engaging in clinical work at Oklahoma City, to get and to retain a monopoly of the field, the step would doubtless be advisable even now.

all these proposed schools belong to state universities, and even at St. Louis the cooperation of the state university may prove feasible. A close relation may thus be secured between agencies concerned with public health and those devoted to medical education. The public health laboratory may become virtually part of the medical school—a highly stimulating relation for both parties. The school will profit by contact with concrete problems; the public health laboratory will inevitably push beyond routine, prosecuting in a scientific spirit the practical tasks referred to it from all portions of the state. The direct connection of the state with a medical school that it wholly or even partly maintains will also solve the vexed question of standards: for the educational standard which the state fixes for its own sons will be made the practise standard as well. Private corporations, whether within or without its borders, will no longer be permitted to deluge the community with an inferior product.

6. Seven thinly settled and on the whole slowly growing states and territories form the farther west: New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona. Their increase in population was last year about 45,000. They contain now one doctor for every 563 persons. In view of local conditions, let us reckon one additional doctor for every additional 750 persons: 60 will be required. And, further, let us make up the death-roll man for man: 60 more would be needed—altogether 120. There are at the moment in this region only two available sites, Salt Lake City and Denver. At the former the University of Utah is situated; the latter could be occupied by the University of Colorado, located at Boulder, practically a suburb. The outlying portions of this vast territory will long continue to procure their doctors by immigration or by sending their sons to Minneapolis, Madison, Ann Arbor, Chicago or St. Louis.

The three states on the Pacific coast, California, Oregon, Washington, are somewhat self-contained. They increased last year by 53,454 persons, requiring 36 more physicians; 50 more would repair one half the losses by death: a total of 86. Available sites, filling the essential requirements, are Berkeley and Seattle. The former, with the adjoining towns of Alameda and Oakland, controls a population of 250,000 or more; the medical department of the University of California concentrated there would enjoy ideal conditions. At present the clinical ends of two divided schools share San Francisco, and the outlook for medical education of high quality is rendered dubious by the division. With unique wisdom the University of Washington and the physicians of Seattle have thus far refrained from starting a medical school in that state. They have held, and rightly, that in the present highly overcrowded condition of the profession on the coast, there is no need for an additional ordinary school; and the resources of the university are not yet adequate to a really creditable establishment. The field will therefore be kept clear until the university is in position to occupy it to advantage.

8. In Canada the existing ratio of physicians to population is 1:1030. The estimated increase in population last year was 239,516, requiring 160 new physicians; losses by death are estimated at 90. As the country is thinly settled and doctors much less abundant than in the United States, let us suppose these replaced man for man: 250 more doctors would be annually required. The task of supplying them could be for the moment safely left to the universities of Toronto and Manitoba, to McGill and to Laval at Quebec. Halifax,

Western (London) and Laval at Montreal have no present function. At some future time doubtless Dalhousie University at Halifax will need to create a medical department. The future of Queen's depends on its ability to develop halfway between Toronto and Montreal, despite comparative inaccessibility, the Ann Arbor type of school. As for the rest, the great northwestern territory will, as it develops, create whatever additional facilities it may require.

In so far as the United States is concerned, the foregoing sketch calls for 31 medical schools with a present annual output of about 2,000 physicians, *i. e.*, an average graduating class of about 70 each. They are capable of producing 3,500. All are university departments, busy in advancing knowledge as well as in training doctors. Nineteen are situated in large cities with the universities of which they are organic parts; four are in small towns with their universities; eight are located in large towns always close by the parent institutions. Divided and far distant departments are altogether avoided.

Twenty states[9] are left without a complete school. Most of these are unlikely to be favorably circumstanced for the next half century, so far as we can now judge. Several may, however, find the undertaking feasible within a decade or two. The University of Arkansas might be moved from Fayetteville to Little Rock; Oklahoma, if its rapid growth is maintained, may from Norman govern a medical school at Oklahoma City; Oregon may take full responsibility for Portland. Unfortunately, of the three additional schools thus created, only one, that at Little Rock, would represent conditions at their best. There is therefore no reason to hasten the others; for their problem may, if left open, be more advantageously solved.

To bring about the proposed reconstruction, some 120 schools have been apparently wiped off the map. As a matter of fact, our procedure is far less radical than would thus appear. Of the 120 schools that disappear, 37 are already negligible, for they contain less than 50 students apiece; 13 more contain between 50 and 75 students each, and 16 more between 75 and 100. That is, of the 120 schools, 66 are so small that their student bodies can, in so far as they are worthy, be swept into strong institutions without seriously stretching their present enrolment. Of the 30 institutions that remain, several will survive through merger. For example, the Cleveland College of Physicians and Surgeons could be consolidated with Western Reserve; the amalgamation of Jefferson Medical College and the University of Pennsylvania would make one fair-sized school on an enforced two-year college standard; Tufts and Harvard, Vanderbilt and the University of Tennessee, Creighton and the University of Nebraska, would, if joined, form institutions of moderate size, capable of considerable expansion before reaching the limit of efficiency.

In order that these mergers may be effective, not only institutional, but personal ambition must be sacrificed. It is an advantage when two schools come together; but the advantage is gravely qualified if the new faculty is the arithmetical sum of both former faculties. The mergers at Cincinnati, Indianapolis, Louisville, Nashville, have been arranged in this way. The fundamental principles of faculty organization are thus sacrificed. Unless combina-

[9] They are Maine, New Hampshire, Vermont, West Virginia, North Carolina, South Carolina, Florida, Mississippi, Kentucky, Arkansas, Oklahoma, North Dakota, South Dakota, Montana, Wyoming, Idaho, New Mexico, Arizona, Nevada, Oregon. One school will not long content the state of Texas.

tion is to destroy organization, titles must be shaved when schools unite. There must be one professor of medicine, one professor of surgery, etc., to whom others are properly subordinated. What with superabundant professorial appointments, due now to desire to annex another hospital, and again to annexation of another school, faculties have become unmanageably large, viewed either as teaching, research, or administrative bodies.

Reduction of our 155 medical schools to 31 would deprive of a medical school no section that is now capable of maintaining one. It would threaten no scarcity of physicians until the country's development actually required more than 3,500 physicians annually, that is to say, for a generation or two, at least. Meanwhile, the outline proposed involves no artificial standardization: it concedes a different standard to the south as long as local needs require; it concedes the small town university type where it is clearly of advantage to adhere to it; it varies the general ratio in thinly settled regions; and, finally, it provides a system capable without overstraining of producing twice as many doctors as we suppose the country now to need. In other words, we may be wholly mistaken in our figures without in the least impairing the feasibility of the kind of renovation that has been outlined; and every institution arranged for can be expected to make some useful contribution to knowledge and progress.

The right of the state to deal with the entire subject in its own interest can assuredly not be gainsaid. The physician is a social instrument. If there were no disease, there would be no doctors. And as disease has consequences that immediately go beyond the individual specifically affected, society is bound to protect itself against unnecessary spread of loss or danger. It matters not that the making of doctors has been to some extent left to private institutions. The state already makes certain regulations; it can by the same right make others. Practically the medical school is a public service corporation. It is chartered by the state; it utilizes public hospitals on the ground of the social nature of its service. The medical school can not then escape social criticism and regulation. It was left to itself while society knew no better. But civilization consists in the legal registration of gains won by science and experience; and science and experience have together established the terms upon which medicine can be most useful. "In the old days," says Metchnikoff,[10] "anyone was allowed to practise medicine, because there was no medical science and nothing was exact. Even at the present time among less civilized people, any old woman is allowed to be a midwife. Among more civilized races, differentiation has taken place and childbirths are attended by women of special training who are midwives by diploma. In case of nations stilll more civilized, the trained midwives are directed by obstetric physicians who have specialized in the conducting of labor. This high degree of differentiation has arisen with and has itself aided the progress of obstetrical science." Legislation which should procure for all the advantage of such conditions as is now possible would speedily bring about a reconstruction quite as extensive as that described.

Such control in the social interest inevitably encounters the objection that individualism is thereby impaired. So it is, at that level; so it is intended. The community through such regulation undertakes to abridge the freedom of particular individuals to exploit certain conditions for their

[10] "The Nature of Man" (translated by Chalmers), p. 300.

personal benefit. But its aim is thereby to secure for all others more freedom at a higher level. Society forbids a company of physicians to pour out upon the community a horde of ill-trained physicians. Their liberty is indeed clipped. As a result, however, more competent doctors being trained under the auspices of the state itself, the public health is improved; the physical well-being of the wage-worker is heightened; and a restriction put upon the liberty, so-called, of a dozen doctors increases the effectual liberty of all other citizens. Has democracy, then, really suffered a set-back? Reorganization along rational lines involves the strengthening, not the weakening, of democratic principle, because it tends to provide the conditions upon which well-being and effectual liberty depend.

HENRY AUGUSTUS TORREY[1]

Henry Augustus Torrey, assistant professor of chemistry and member of this faculty for the last seven years, died of endocarditis on Friday, March 25, at his home, 5 Fuller Place, Cambridge, after an illness of several weeks.

Torrey was born on August 29, 1871, at Burlington, Vt., the son of Professor Henry A. P. Torrey, of the philosophical department of the University of Vermont, and Sarah Paine Torrey, daughter of the late President Torrey of the same university. Thus he came on both sides from families noted in the educational world. He received the degree of bachelor of arts from the University of Vermont in 1893, and in the following year took a position as assistant in food investigations at Middletown, Conn., going thence to Harvard in 1895. From Harvard he received the degree of master of arts in 1896 and doctor of philosophy in 1897, as well as a Parker fellowship in the following year, which he devoted to study in Leipzig and Berlin. On his return from Europe in 1898 he became instructor in the University of Vermont, where he was made assistant professor in 1899. In 1903 he was called to an instructorship at Harvard, and was promoted in 1905 to the assistant professorship which he held at the time of his death. In 1906 he was married to Miss Dorothy Van Patten, of Davenport, Ia., who with one son survives him.

Torrey was selected as instructor in organic chemistry after careful deliberation and much thought, because he was believed to combine in rare degree all the varied attributes needed by the successful teacher and investigator; and his work immediately vindicated the choice. In his lectures he succeeded in so illuminating an involved and technical subject as to show clearly the vivid interest of its underlying facts and theories; and through his numerous papers on structural organic chemistry he had already begun to make his mark among those who seek to discover not merely the products but also the mechanism of organic changes. His knowledge of physical chemistry contributed greatly to his power of solving the new problems which daily confront the organic chemist. His academic advancement was assured, he loved the university, and rejoiced in his opportunity to serve her. His place is very hard to fill.

His kindly and sympathetic personality won for him many friends among both the faculty and the students. All who knew him prized very highly his ideals and his faithfulness in ever seeking to attain them. Among the students he was unusually popular, not because his courses were easy (they were indeed unusually difficult), but because the men appreciated his intelligence and his uprightness as well as his vivifying similes and his quaint sense of humor. Few even among his intimates realized fully the heroism with which he threw himself into his work. His health was frail, and he well knew its frailty; but he never faltered. His courage was none the less real because it was silent and unobtrusive. He leaves with us poignant regret for his untimely death, an enduring reverence for the

[1] Read at the meeting of the faculty of arts and sciences of Harvard University, and entered upon its records, June 21, 1910.

brave and able fulfillment of his duty, and warmly affectionate memories of the man himself.

THEODORE W. RICHARDS
GREGORY P. BAXTER
BRUCE WYMAN

THE MUSEUM OF VERTEBRATE ZOOLOGY OF THE UNIVERSITY OF CALIFORNIA

THE Museum of Vertebrate Zoology of the University of California is represented during the present year by parties carrying on faunistic exploration in three regions.

The expedition to the Colorado Valley under the immediate leadership of Joseph Grinnell, director of the museum, returned on May 17, after three months' work along the river from Needles to Yuma. Over 3,000 specimens of mammals, birds, and reptiles were obtained, some of the species being new to the known fauna of California. The important fact was brought out that the Colorado River serves, at least in this portion of its course, as an effectual barrier for at least ten species of small mammals; that is, in no one of these cases does the range of the species cross the river. For example, three species of pocket-mice (*Perognathus*) occur abundantly on the Arizona side, and three other and distinct species occupy corresponding associational belts on the California side.

Mr. Walter P. Taylor, assistant in the museum, now has a party in the Warner Mountain region of extreme northeastern California. It is already apparent from their work since entering the region May 15, that the Sierran and Great Basin faunas are curiously blended in the Warner Mountains. To express it otherwise, there is an uneven intermixture of the representative elements of the two regions.

Miss Annie M. Alexander, founder and patron of the museum, is with three assistants exploring the interior of northern Vancouver Island. Specimens have been obtained there of a distinct form of beaver, and of mountain lion, black bear, and other carnivorous mammals, besides large series of the smaller mammals and birds. The work on Vancouver Island began in April and will extend through September. The results are expected to add to the knowledge of the zoogeography of the region.

All the specimens and field notes obtained on these three expeditions become the property of the University of California, and on them are to be based special faunal studies.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE Board of Directors of the Rockefeller Institute for Medical Research announce the following promotions and appointments for the year 1910–11:

Laboratory Staff

Member: Jacques Loeb, experimental biology.

Associates: W. A. Jacobs, biological chemistry; D. R. Joseph, physiology and pharmacology; Peyton Rous, pathology; B. T. Terry, protozoology; D. D. Van Slyke, biological chemistry.

Assistants: M. T. Burrows, experimental surgery; P. F. Clark, bacteriology; I. S. Kleiner, physiology and pharmacology; Hardolph Wasteneys, experimental biology.

Fellows: F. J. Birchard, biological chemistry; F. B. La Forge, biological chemistry.

Scholar: J. Bronfenbrenner, pathology.

Hospital Staff

Resident physician: G. Canby Robinson.

Internes: George Draper, H. K. Marks, F. W. Peabody, H. F. Swift.

General Manager—Jerome D. Greene.

SCIENTIFIC NOTES AND NEWS

AT a dinner at the Athenæum Club, London, on July 1, President Nicholas Murray Butler presented to Professor Ernest Rutherford, of the University of Manchester, the Barnard medal, which had been awarded to him by Columbia University on the recommendation of the National Academy of Sciences.

DR. HUGO MÜNSTERBERG, professor of psychology at Harvard University, sailed for Germany on July 2. He will be next year the Harvard exchange professor with the University of Berlin, and will at the same time organize and be the first director of an Ameri-

can Institute, established as a clearing house for intellectual relations between Germany and America.

The trustees of Cornell University have passed resolutions on the retirement of Professor Wait and Professor Wilder, and their appointment as emeritus professors as follows:

Resolved, that on the retirement at the end of the academic year 1909–10 of Professor Lucien Augustus Wait, who has faithfully served the university in the department of mathematics for forty years and has been in charge of its administration for a third of a century, the members of the board of trustees hereby place upon record their high appreciation of his services to the university as a devoted professor and efficient administrator in one of its largest departments; and that this board (many of whose members have been among Professor Wait's pupils) join with hundreds of Cornell alumni in paying hearty tribute to his worth as an educator and a man, and in wishing for him many years of health and happiness.

Resolved, that on the retirement at the close of the present academic year of Burt Green Wilder, professor of neurology and vertebrate zoology, the trustees record their appreciation of his long and devoted service, beginning with the day that the university first opened its doors to receive students and continuing through two and forty years until the present time, a lifetime freely and unselfishly given to the cause of science, and an inspiring example to hundreds of his students of that eager love for the truth characteristic of him as it was of his own masters, Gray, Holmes, Wyman and Agassiz. Recalling the fact that he is the last of the original faculty in active service, the trustees wish him many years of health and continued activity in the chosen field of his labors.

Among the honorary degrees conferred by Harvard University at its recent commencement exercises were the doctorate of laws on President R. C. Maclaurin, and the doctorate of science on Sir John Murray, Professor Theodore W. Richards and Professor Theobald Smith. The characterizations used by President Lowell in conferring these degrees were as follows: Richard Cockburn Maclaurin, a scholar distinguished in three continents for his knowledge of the laws of nature and of man, whom we welcome as a friend, and honor for his own talents and as president of our most celebrated school for engineers; Sir John Murray, one of the pioneers in the *Challenger*, who searched the bed of the ocean, year by year, more famous as an explorer into the depths of its silence and its mystery; Theodore William Richards, a chemist who has weighed the atoms in his balance; an explorer to whom the elements of the universe have told their secret; a modest seer of things invisible to man. Theobald Smith, discoverer of the cause of Texas fever, who taught men to seek in insects the source of human plagues; he stands among the great benefactors of mankind.

Cambridge University has conferred its doctorate of science on Sir Oliver Lodge, principal of the University of Birmingham, and Professor William Henry Perkin, professor of organic chemistry in the University of Manchester.

Senator Blaserna, professor of physics at Rome, has been elected a corresponding member of the Paris Academy of Sciences.

Dr. Wilhelm Roux, professor of anatomy at Halle, has been elected an honorary member of the Royal Academy of Medicine at Turin.

Graf von Zeppelin has been appointed a knight of the Prussian order pour le mérite.

The Baumgartner prize of the value of 2,000 crowns, of the Vienna Academy of Sciences, has been awarded to Dr. Stark, for his work on electrons.

The statement that Professor Oscar Bolza, who becomes non-resident professor in the University of Chicago, and will hereafter live in Freiburg, Germany, will receive his salary from the university, is incorrect.

Dr. Truman Michelson and Dr. Paul Radin, both of whom have been working at Columbia University under Professor Franz Boas, have been appointed ethnologists in the Bureau of American Ethnology.

Dr. Oskar C. Gruner, clinical pathologist to the General Infirmary, Leeds, has been appointed pathologist to the Royal Victoria Hospital, Montreal, and lecturer on pathology at McGill University.

PROFESSOR THOMAS A. JAGGAR, JR., of the department of geology of the Massachusetts Institute of Technology, and Professor Charles Spofford, of the department of civil engineering, are now in Costa Rica making a study into the cause and nature of earthquakes and the type of structures and architecture best suited to resist earthquakes.

DR. H. H. RUSBY will spend the summer in Mexico in connection with his investigations of the new rubber-producing tree, *Euphorbiodendron fulvum*. Advantage will be taken of this opportunity for making collections for the New York Botanical Garden, especially of economic material, and for the investigation of Mexican drugs and medicinal plants in the interest of the United States Pharmacopœia.

MR. W. W. EGGLESTON has been appointed assistant botanist of the Forest Service and he has been detailed to study poisonous forage plants in Colorado in cooperation with the Bureau of Plant Industry.

PROFESSOR FREDERICK STARR, of the department of sociology and anthropology of the University of Chicago, has returned from an eight-months' stay in Japan, where he conducted anthropological researches.

MR. J. W. ROBERTSON, late principal of the MacDonald Agricultural College, has been appointed chairman of a commission to investigate the need for technical education in Canada.

DR. RAPHAEL MELDOLA, professor of chemistry in Finsbury Technical College, will give the next Herbert Spencer lecture at Oxford University.

THE ninety-third annual meeting of the Swiss Society of Natural Sciences is to be held at Bâle on September 4–7. Lectures will be delivered by Professor W. Ostwald, of Leipzig, and Professor E. von Drygalski, of Munich. The Swiss Societies of Botany, Chemistry, Geology, Physics, Zoology and Mathematics will meet in affiliation with the general society.

THE Berlin correspondent of the *Journal* of the American Medical Association states that the ashes of Robert Koch, cremated in Baden-Baden, have been brought to the Institute for Infectious Diseases, in Berlin, which was the place of his labors for the last decade, and they will be permanently installed in a room which, with the permission of the national authorities, is to be converted into a mausoleum for Koch. In this room also there will be placed the bust, contributed by his pupils on his sixtieth birthday, his works and other memorials. A memorial room will be produced, similar to the one which has been provided for Pasteur in his Paris institute. In order to avoid a large number of single memorial services in the various societies of which Koch was an honorary member, a committee has been formed which is preparing a single memorial service for all these bodies in common. The date for this celebration has been postponed to December 11 of this year, which will be the sixty-seventh birthday of Robert Koch; this resolution has been taken because, as is generally understood, in the next few weeks many of the persons who would be interested in this memorial will be away from home, and, moreover, because representatives from foreign countries are expected at the celebration, and finally because Koch himself wished a quiet interment. The memorial address at the proposed service will be delivered by Dr. Gaffky, the oldest pupil of Koch and his successor in the directorship of the Institute for Infectious Diseases.

IN the National Institute for Bacteriology in the City of Mexico, there was, on June 24, unveiled a memorial tablet to Dr. Howard T. Ricketts, of the University of Chicago, who lost his life in the course of his research on Mexican typhus.

DR. CHARLES A. WHITE, formerly state geologist of Iowa, member of the U. S. Geological Survey and of the National Academy of Sciences, died on June 29, at Washington, D. C., in his eighty-fifth year, after an illness of some months.

DR. CYRUS THOMAS, archeologist in the Bureau of American Ethnology since 1882, well known for his contributions to anthropology, died on June 27, in Washington, at the age of eighty-five years.

Dr. Henry Harris Aubrey Beach, a physician of Boston, formerly demonstrator in anatomy and lecturer in surgery in the Harvard Medical School, died on June 28, at the age of sixty-seven years.

There has been established at Chicago the Otho S. A. Sprague Memorial Institute for the Scientific Investigation of the Causes of Disease, by the will of the Chicago merchant whose name it bears. The endowment is $1,000,000, which it is said may be considerably increased.

Congress has passed the bill appropriating $50,000 to establish a biological laboratory for the study of diseases of fish, especially those related to cancer. The station is to be established under the U. S. Fish Commission.

Through the generosity of Mr. Anson W. Hard, the American Museum of Natural History has secured an extensive series of old and valuable serapes and other blankets made by the Saltillo and other Indian tribes of Mexico and several of the tribes of the southwest.

The fourth International Congress of Philosophy will be held at Bologna at Easter, 1911.

The Harvard Summer School of field geology, endowed by Mr. Robert W. Sayles, will be held in Montana for five weeks in July and August under the direction of Professors J. B. Woodworth and J. W. Eggleston (recently appointed at the School of Mines, Rolla, Mo.). The Boston members of the school, about eighteen in number, started on July 5 in a special car for Bozeman.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Edward Whitney the Massachusetts Institute of Technology, receives $25,000 for work in geophysics.

At a recent meeting of the trustees of the University of Illinois the annual budget for 1910–11, $1,229,368, was voted. This does not include the sums appropriated by the state legislature for the permanent improvement of the plant. The trustees accepted a gift from the Chicago Northwestern Railway Company, of the Locomotive Testing plant at Fortieth Street shops. This plant will be removed to the university in Urbana.

The electrical laboratory presented to Oxford University by the Drapers' Company, and erected on the north side of the University Museum at a cost of £23,000, was formally opened on June 21.

At the University of Pennsylvania hereafter the chairman of each department of instruction will be elected annually by the department. For the year 1910–11, Professor G. E. Fisher has been elected chairman of the department of mathematics in the graduate school, and Professor I. J. Schwatt, chairman of the mathematics department in the college.

Appointments to the faculty were made by the regents of the University of Wisconsin at the commencement meeting as follows: A professorship of manual arts in the course for the training of teachers was established, and Professor F. D. Crawshaw, of the University of Illinois, was elected to the new chair. Dr. J. A. E. Eyster, of the University of Virginia, was made professor of physiology to succeed Dr. Joseph Erlanger, who resigned to accept the position of the head of the department of physiology in the medical school of Washington University. F. B. Hadley, of Ohio State University, was appointed assistant professor of veterinary science. Edward J. Ward, now supervisor of social centers and playgrounds in the city of Rochester, N. Y., was appointed acting secretary of the welfare department of the university extension division. The following new instructors were appointed: E. E. Moots, mathematics; E. M. Gilbert, botany; O. Butler, horticulture; S. E. Johnson, mechanics; Dr. Robert Van Valzah, medicine; W. C. Rowse, steam and gas engineering. The new assistants elected were: G. A. Russell and Frieda Bachman, botany; Vanette MacDonald, herbarium; Paul H. Dyke, R. R. Chamberlin, T. M. Dahm, R. L. Wegel, T. J. Littelton, Phillip Rosenberg, R. G. Sherwood, A. L. Tarrell, E. B. Young, R. T. Birge, O. J. Zabel, Harriet B. Merrill, zoology; R. A. Baker, O. L. Barnebey, G. Dietrichson, W. S. Hubbard, Eldin V. Lynn, E. S.

Millard, H. A. Schuette, chemistry; W. P. Gee, J. E. Wodsedalek, zoology; H. M. Helm, anatomy.

THE following appointments in scientific departments have been made at Northwestern University: Dr. George T. Hargitt, son of Professor Chas. W. Hargitt, instructor in zoology; William Logan Woodburn, instructor in botany; Dr. Charles D. Brooks, son of the late Professor William K. Brooks, instructor in mathematics.

THE University of Leeds has received £11,000 from various sources for the endowment of a professorship of applied chemistry relating to the coal industries, as a memorial to the late Sir George Livesey.

DR. FRANK BECHT, of the University of Chicago, has been appointed assistant professor and head of the department of physiology at the University of Illinois.

AT the University of Pennsylvania, Dr. G. H. Hallett has been promoted from an assistant professorship of mathematics to the rank of professor. Dr. M. J. Babb, Dr. G. G. Chambers and Dr. O. E. Glenn have been promoted from instructors to be assistant professors of mathematics.

DR. LEROY MCMASTER has been advanced to the rank of assistant professor of chemistry at Washington University.

MR. J. K. JAMESON has been appointed to the chair of anatomy at Leeds, vacant by the resignation of Professor Griffith, who has accepted the professorship of medicine.

DISCUSSION AND CORRESPONDENCE

BOTANICAL GARDENS

TO THE EDITOR OF SCIENCE: While I am ready to subscribe to the ideas expressed in the Symposium on Botanical Gardens given before Section G of the American Association for the Advancement of Science, at the Boston meeting held December, 1909, and published in the April 29 issue of SCIENCE, I regret that the most important work was not sufficiently dwelt upon. The ecological, biological, morphological, physiological, esthetic and educational features of botanical gardens were clearly set forth. This is, indeed, all well and good, but it leaves yet much to be done.

A botanical garden should be essentially experimental, dominated by an economical, practical method. All of the other features above indicated should be made subsidiary. In other words the botanical garden should have an economically commercial significance. Its chief function should be to develop the economic botanical resources of the country. To this end the garden should be divided into two distinct parts. In one should be carried on the purely experimental work—that is, experimental work having a practical significance. In the second part should be carried on test plantings on a practically economic commercial basis. Such gardens need not be large nor expensive, and they should be distributed geographically and climatologically, in order that the greatest good might be accomplished with a minimum of expenditure. The idea is in the main carried out by Kew with its substations and by the experimental stations of the U. S. Department of Agriculture, excepting that the monetary outlay involved is too great and the mistake is made of controlling substations from one central point. For example, nothing can be more absurd than a management in London directing affairs in India or in South America, or the authorities at Washington directing or controlling the experimental work in California, Florida or Texas. In fact, as far as the United States are concerned, each state should support, direct and control its own experimental work absolutely, with, of course, a cooperative relationship with the experimental gardens or stations of other states. A very efficient state garden of this kind does not require more than ten acres of ground, a propagating house, a tool shed, an office with store rooms, a competent director, one technical assistant, two or three skilled gardeners and the necessary additional equipment. The annual cost of maintaining such a garden in high operative efficiency need not exceed $10,000. The financial gain to the state to be derived from such a garden would soon amount to millions of dollars annually. To

illustrate, at a cost of about $10,000 it has been demonstrated experimentally how belladonna can be grown commercially in California. There is no plausible reason why California should not supply all or nearly all of the belladonna required in the United States, which may be estimated at about 1,000,000 pounds annually valued at $150,000. This is merely one example which will however serve to explain the practical purpose of a botanical garden as above outlined. The probabilities are that from five to twenty-five practical tests would be carried on at one time and perhaps two or three tests would be concluded each year. From what has been said it is evident that the gardens should devote the major effort to establishing new plant industries and developing them. No time and effort should be wasted on useless things, as botanical freaks, botanical curios, purely technical research without practical significance, theoretical research and experiments, etc. Neither should time and effort be wasted on simple experiments which can be done by any agriculturist in any field or garden. Also, such gardens must be in charge of competent directors, men who by technical training and practical experience are qualified to direct such experiments as will bring practical net results in the shortest time possible.

Albert Schneider

CLASSIFICATION OF THE EDENTATES

Dr. E. H. Lane, in "A Corrected Classification of the Edentates,"[1] has proposed the new ordinal name Lepidota for the Manidæ. That, like Squamata and Pholidota, was however long ago preoccupied (by Vogt in 1851), as was also Cataphracta, another designation proposed by J. E. Gray. Squamigera, having the same meaning, might be taken as a substitute, but such is scarcely necessary, as Nomarthra may be restricted to the suborder (or order) represented by Manids alone. I concur now with Weber, G. Elliot Smith, Gregory and Lane in thinking it inadvisable to combine the Manids and Orycteropodids in a group contrasted with the Xenarthra.

I can not consider the combination of sloths and anteaters in a group distinct from the armadillos as an improvement in the taxonomy of the Xenarthra, and therefore the name Pilosa appears to me to be superfluous. Flower himself virtually confesses as much. The suborders Tardigrada and Vermilinguia, recognized by me in 1872, appear to be at least as distinct as are the "Loricata" from the Tardigrada.

If we are to apply the same rigorous rules to the nomenclature of the higher groups as to genera and species, "Loricata Flower" is another preoccupied name (unless accepted from Vicq d'Azyr) unusable for the armadillos and their relatives. Instead, Cingulata of Illiger (1811) might be revived as a subordinal term.

Vermilinguia of Illiger was long ago (1872) accepted as a subordinal designation for the anteaters.

Structural differences among the "Loricata" or Cingulata appear to be as great as (or greater than) those which have been used to distinguish families among the better-known carnivores, ungulates and rodents, and consequently have been recognized under the family names Tatusiidæ, Dasypodidæ and Chlamyphoridæ. These have been indicated in the "Standard (or Riverside) Natural History."

Hoplophoridæ (Huxley), 1864, appears to be retainable, Glyptodontidæ not having been given till years after (1879). *Hoplophorus* (Lund, 1838) is not preoccupied, in the opinion of many, by *Hoplophora* (Perty, 1830).

There are other complications in the classification and nomenclature of the edentates which need not be considered at this time.

Theo. Gill

[1] Science, June 10, 1910, 913–914.

SCIENTIFIC BOOKS

Fungous Diseases of Plants. With Chapters on Physiology, Culture Methods and Technique. By Benjamin Minge Duggar. Boston, New York, Chicago and London, Ginn & Co. 1909. Price $2.00.

The appearance of an American book on plant pathology is a matter of great interest to a considerable circle of readers. For the

last twenty-five years the study of plant pathology has been prosecuted in this country as it has been perhaps in no other country in the world, owing to the simultaneous founding of agricultural experiment stations in all of the states, and the devotion of a good deal of time and energy to the same subject in the U. S. Department of Agriculture. This is the first book on the subject that has appeared in the United States, if we except a little brochure by Professor Scribner, now many years old, and the recent book on "Minnesota Plant Diseases" by Freeman, which contains many good illustrations but a somewhat slighter framework of text. The study of plant pathology being older in Europe, they have a correspondingly larger literature and this includes a number of well-recognized and useful manuals. The appearance of Dr. Duggar's book invites comparison with these standard works, *e. g.*, those of Marshall Ward in England; Tubeuf, Sorauer, Kirchner and Frank in Germany; Prillieux and Delacroix in France, and of Comes in Italy. The book stands such a comparison very well indeed. It is less voluminous than the continental works cited, but what it lacks in volume it more than makes up in general accuracy of statement. It is also a matter of unfeigned pleasure that the book deals chiefly with American diseases, and is illustrated almost altogether with photographs and drawings from American material. The illustrations and the letter-press are almost all that could be desired. Indeed, considering the technical character of the book, it is remarkably free from typographical errors. Rarely is there any obscurity. On the other hand, there is usually great perspicacity of statement and freedom from speculation. The relative amount of space devoted to the various diseases also seems on the whole good. The introductory chapters dealing with technic appear to be in the main sufficient, there is a useful host index as well as a general index, and the first impression that one gets of the book outside and in is one of delight. How well the book will wear can be told only by those who have occasion to use it daily in the class room and elsewhere. The writer has read it entirely through without finding many serious errors. There are occasional slips in statement, and omissions in bibliography which will naturally be corrected in a second edition. One looks here and there in vain for reference to certain diseases, and an account of these might also well appear in such a second edition, where more space should be devoted to diseases of forest trees. With addition of a hundred more diseases having special reference to the needs of the British colonies, the book might answer very well as a hand-book of plant pathology for the whole English-speaking world. The book is designed not only for the special student, but also for the intelligent layman whose curiosity has been excited, or whose financial losses lead him to desire information on plant diseases. To the writer the book appears to be not quite encyclopædic enough, *i. e.*, whoever consults such a book would be glad to find at least a little about the particular disease he searches for, and in this book he will sometimes be disappointed. If the reader is also a physiologist he might be led to wonder why Dr. Duggar, who holds the chair of physiology in one of our leading universities, should write a text-book of plant pathology dealing with the subject chiefly from the standpoint of the parasite, and only incidentally from that of the host plant. This is the older view of the whole subject, and this aspect has received more consideration than the physiological one. The explanation may be that Dr. Duggar preferred to reserve the physiological side of the question for a second text-book, or that he felt incompetent to deal with the multitude of problems, many of them unsettled, which one has to face when plant diseases are regarded from the aspect of the plant rather than from the aspect of the parasite. The newness of this latter view and the impossibility of finding at the present time any man anywhere in the world who is competent to write such a book seem to me sufficiently valid excuses if any need be offered. In what I have said I do not mean it to be understood that somebody could not be found who might be able to treat a particular disease or a little group of diseases from a purely physiological stand-

point, but I think the statement I have just made for plant diseases as a whole is quite true. The late Marshall Ward came the nearest perhaps to being such a man, and yet to the writer Dr. Duggar's book shows a better grasp of the whole subject and is more interesting than either one of the books which Marshall Ward published. All criticisms of this sort would have been forestalled by the use of a slightly different title.

In conclusion the writer feels like recommending this book heartily and hopes that it may have so prompt and wide a circulation in this country that a new edition may be called for soon. Meanwhile for the digestion of the physiological critics, it may be suggested that it is a good deal easier to point out the defects in a good book than it is to write a better one. Undoubtedly the ideal plant pathology would be one in which a just balance is kept between the activities of the parasite on the one hand and the reactions of the host plant on the other, and when we know enough about these two subjects, then it will be very easy to write such a book, but the time is not yet. Meanwhile, let us take what we can get and be thankful, particularly when it is as good as the volume in question.

Erwin F. Smith
U. S. Department of Agriculture

Zoology of the Indian Ocean

The Percy Sladen Trust Expedition to the Indian Ocean in 1905. Reports 22–33. (Trans. Linnean Soc. London, 2d Ser., Zoology. Vol. XIII., Pts. 1 and 2, October, 1909, February, 1910.)

The important collections brought back from the islands of the Indian Ocean by the expedition under the leadership of Mr. J. Stanley Gardiner continue to furnish material for reports by different specialists. Reports 22 to 33, now before us, are the following: Nemerteans, by R. C. Punnett and C. Forster Cooper; Echinoderma (exclusive of Holothurians), by F. Jeffrey Bell; Cirripedes, by A. Gruvel; Rhynchota, by W. L. Distant; Amphipoda Hyperiidea, by A. O. Walker; Land and Freshwater Mollusca, by E. R. Sykes; Marine Mollusca, by J. Cosmo Melvill; Alcyonarians, by J. Arthur Thomson, E. S. Russell and D. L. Mackinnon; Cephalochorda, by H. O. S. Gibson; Crustacea (Penæidea, Stenopidea and Reptantia), by L. A. Borradaile; Lepidoptera (exclusive of Tortricidæ and Tineidæ), by T. Bainbrigge Fletcher; Polychæta, part 2, by F. A. Potts. Perhaps the most interesting is that of Mr. H. O. S. Gibson, on the so-called genus *Amphioxides,* which appears to consist of larval forms of Branchiostomids. The expedition brought back abundant material, representing Goldschmidt's species *A. pelagicus* and *A. valdiviæ,* which are believed to belong to *Asymmetron* and *Heteropleuron,* respectively. Mr. Gibson gives a very elaborate discussion of their structure and affinities, but shows that more material and observations are needed to complete the chain of evidence.

The land fauna of the Seychelles is of great interest, owing to the position of the islands between Africa (and especially Madagascar) and India. There are rather numerous precinctive birds and reptiles, and one would expect the various groups of invertebrates, when thoroughly collected, to yield many remarkable species. Mr. Sykes gives us a list of the Mollusca, describing three as new. He remarks: "Very little can be at present stated as to the origin of the fauna: *Streptaxis* shows African influence, *Stylodonta* that of Madagascar, while *Cyathopoma* is mainly Indian. The connection with any mainland must have been at a very remote period, from the well-marked forms (*Acanthennea, Priodiscus,* etc.) now found." The list given is incomplete, from the omission of five species of *Veronicella.* Mr. Distant lists the Rhynchota or Hemiptera of the Seychelles, which so far include 51 Heteroptera and 12 Homoptera (not counting Coccidæ).[1] Of all these, it appears that five genera and 28 species are ostensibly precinctive, but as the Hemiptera of Madagascar are still very imperfectly known, no particular significance can attach to these

[1] This enumeration includes not only the Seychelles, but the Farqunar, Amirante and Coetivy groups.

figures. Unfortunately Mr. Distant, in describing the new genera and species, scarcely ever makes any comparisons with their allies. The same criticism may be made of many of Mr. Fletcher's descriptions of Seychelles Lepidoptera, and of numerous other recent publications of new species of insects. If the species or genera described have been ascertained to be new, they must have been compared with their relatives, and there seems to be no excuse for omitting information on this point, which would be of so much service to subsequent workers. Mr. Fletcher's long and elaborate account of the Lepidoptera brings out a number of interesting facts. For the Seychelles proper he enumerates 120 species, of which only 17 appear to be precinctive. Putting aside the widely-spread forms, the specially Indian element is very small; the African is distinctly greater. Among the butterflies, only a single species (*Parnara morella*) is peculiar to the Seychelles; two others are confined to Aldabra and the Seychelles. In a brief account of the Lepidoptera of the Chagos Archipelago 26 species are enumerated, three being precinctive. One butterfly (*Junonia vellida*) is Australian, and is supposed to have arrived by way of Christmas Island.

T. D. A. COCKERELL

THE GEOGRAPHY OF FERNS

THE venerable pteridologist, Christ, in the course of a long and exhaustive study has accumulated a wealth of fern information not directly usable in taxonomic publications, which he has lately brought together in a separate volume.[1] His treatment comprises separate analyses of environmental and geographic considerations.

Though of an ancient line of descent with a fairly large persistence of Tertiary or earlier types, and comprising a rather insignificant fraction (considerably less than 10,000 species) of the present vascular flora of the world, the ferns are found to follow the same distributional laws as the more modern and now dominant seed plants and to show similar endemic centers. Though on the one hand tolerant of extreme precipitation, and on the other presenting some of the most marked examples of xerophytic dormancy, they appear to have been in the main less pliable than the seed plants. Few grow where the annual rainfall is less than 25 inches and their lateral and vertical distribution in general agrees with that of forests, their greatest occurrence being coincident with that of the tropical forests under a rainfall of 80 inches or more per year; one only is aquatic, and only two or three are halophytes. In adaptive form they ring nearly all the changes from minute epiphytic or terrestrial herbs to lianas, climbers and trees; and slime protection, nectar secretion, myrmecophily, food and water storage and numerous and varied provisions against drought, parallel those of the spermatophytes. The chief areas differentiated by their floras are: the cool-temperate northern forest regions, the Mediterranean region, China-Japan, Malaya, Australia-New Zealand, tropical Africa, south Africa, the Mexican table-land, tropical America, the south Brazilian campos, the Andes, and the south-Chilean region.

Though sometimes separated from the explanatory text, the many original half-tone illustrations of form and habit add much to the attractiveness and usefulness of what must be regarded as at once an unusual and a valuable contribution to botanical literature—the richness of which in specific information is indicated by a three-column index of over fourteen pages, devoted to the forms mentioned in the text.

W. T.

An Outline of Individual Study. By G. E. PARTRIDGE, Ph.D. New York, Sturgis & Walton. 1910. Pp. v + 240.

This book is intended as a guide for those who wish to engage in the study of individuals. The author believes that it will be of value to superintendents and teachers and that such study might well supplement if not take the place of general psychology in normal schools.

[1] H. Christ, "Die Geographie der Farne," Jena, Verlag von Gustav Fischer, 1910, 8vo, pp. 357, figs. 130, maps 3. Price 12 Marks.

It treats of the nature of individuality, of individual study as a science, the various standpoints for studying individuals, anthropological, biological, etc., and gives many suggestions and directions regarding the study of general physical and mental characteristics of individuals, with special directions and outlines for studying health, growth, movement, emotions, interests, instincts, perception, memory, etc. One chapter is devoted to an original study of two twins and the book closes with a discussion of types of individuality and the pedagogical aspects of individuality. At the close of each topic is given a very serviceable list of references.

The book does not profess to be scientific in the sense of outlining methods for scientific research or summarizing the results of research, but it is scientific in the sense that the author outlines the experiments and observations in accordance with scientific principles such as he and others have used, though he does not usually give detailed descriptions of experiments. In fact, although he wishes to help the teacher, he reveals the fact that his own interest is in determining what is scientifically true, rather than in simply finding out the facts that may guide one in dealing with the individual in question. Such an attitude may, however, be a good thing to maintain before teachers who are perhaps inclined to be rather narrow in their interests and hasty in reaching conclusions.

There is no question that there is a growing demand on the part of teachers of psychology for some simple means of testing individuality and an increasing recognition on the part of superintendents and teachers of the need of some means other than the usual school tests for diagnosing the condition of individual pupils, in order that they may be placed in special classes when necessary or may receive the individual help that they need. It is entirely too much to expect, in this stage of experimental psychology and pedagogy when a committee of the American Psychological Association have been laboring without complete success for several years upon a series of standard tests, that this pioneer book in the field should be satisfactory in every particular. The book is, however, a very creditable attempt at making the methods now being used in the scientific study of man useful to the student of psychology and pedagogy. Detailed criticism would take too much space and be of little value because at the present time probably no two persons would agree as to what should or should not be included in such a book.

E. A. Kirkpatrick

Fitchburg, Mass.

Tent Life in Siberia. Adventures among the Koraks and other tribes in Kamchatka and northern Asia. By George Kennan. New York, G. P. Putnam's Sons. Pp. xix + 482. 8vo. 32 illustrations and maps. 1910.

Forty years ago, when, from the recent purchase of Alaska, public interest in the north Pacific region was still keen, a little volume by a member of the Russo-American Telegraph expedition detailing his experiences in connection with their explorations in eastern Siberia was offered to the public. Its graphic descriptions of conditions in an almost unknown part of the world, and its careful portrayal of the natives and their mode of life, made it a welcome contribution to geography and anthropology, while the charm of its style captivated the reader.

To these qualifications, doubtless, is due the fact, that without newspaper advertising or exploitation, the book has continued to be in demand until the original plates have been worn out. Now the publishers have given us a new edition with additions by the author and illustrated by excellent half tones taken from photographs obtained in the same region by the Jesup Expedition.

Conditions in this remote region have hardly altered since Kennan's time. For a popular account in untechnical language by a reliable observer the book remains unique in English literature, and well worthy of its new and attractive form.

The careful reader may avoid some bewilderment by noting that on the legend of the map the symbols for the proposed tele-

graph line and for Kennan's actual route have been interchanged. WM. H. DALL

SOCIETIES AND ACADEMIES

THE CHEMICAL SOCIETY OF WASHINGTON

A SPECIAL meeting of the society was held on Saturday evening, May 21, at the Johns Hopkins University. Vice-president Skinner called the meeting to order and asked Professor Acree to preside. After a few words of welcome from President Ira Remsen, the following papers were presented:

Temperature Coefficients of Osmotic Pressure: Professor H. N. MORSE.

The report was upon the work of the last two years, during which the temperature coefficient of osmotic pressure has been under investigation. It was shown that in the case of cane sugar solutions ranging in concentration from 0.1 to 1.0 weight-normal—the ratio of osmotic pressure to calculated gas pressure is constant for any given concentration of solution, between 0° and 25°. In other words, that within these limits of concentration and temperature the osmotic pressure of cane sugar solutions obeys the law of Gay-Lussac for gases.

The Relation between Commerce and Scientific and Technical Work: Dr. H. F. BAKER.

Recent Work on the Absorption Spectra of Solutions: Dr. W. W. STRONG.

The absorption spectra of uranyl salts in solution consists of a series of about ten bands running from λ5000 to λ3200. Uranous salts have an entirely different absorption spectra, including bands in the red, yellow and green. It is quite difficult in some cases to obtain the uranous solutions entirely free of the uranyl salts, so that the uranyl bands will appear in the absorption spectra. But by adding hydrogen peroxide and photographing the absorption spectra as the uranous salt is gradually oxidized to the uranyl salt, it is quite easy to differentiate between the uranyl and uranous bands.

It has been found that the absorption spectra in different solvents are very different. As the solvent is gradually changed the uranous bands of one solvent gradually disappear while those of the solvent which is increasing in amount increase in intensity. The wave-lengths of these bands do not change. On the other hand, when the solvent is kept the same and one uranyl or uranous salt is changed into another salt by the addition of acid, the uranyl and uranous bands in general are shifted.

Fractionation of Crude Petroleum by Diffusion through Fuller's Earth: Dr. J. E. GILPIN.

Evidence was presented in favor of the view that one cause, at least, of the differences in petroleum from different localities is due to the degree and nature of the capillary filtration to which they are subjected in passing from their place of origin to the place where they are found.

After the meeting the society adjourned to the Johns Hopkins Club, where a smoker was held. The attendance at the meeting was sixty-two.

J. A. LECLERC,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 231st meeting of the society, held on Wednesday, April 13, 1910, the following papers were read:

Regular Program

Solution and Cementation in Arid Regions: E. E. FREE.

Through soils and other unconsolidated surface deposits there is normally a double movement of water: downward percolation during or following rain, and upward rise by capillarity during periods of surface dryness. In the humid regions the downward percolation is far in excess and the various substances dissolved by the waters from the soil minerals are carried away into the drainage. The soil is subjected to leaching and retains no soluble materials except those held chemically or physically (as *e. g.*, by adsorption) in or on the solid particles of the soil. With decreasing rainfall the relative importance of the downward percolation decreases while that of the capillary rise increases. Under moderate aridity (semi-arid conditions) there is still a net downward flow, but it is insufficient to fully leach the soil and there is a tendency for the accumulation of the less soluble materials (usually lime carbonate) in the subsoil. Thus are formed the well-known lime-cemented subsoils, the "whitewash," etc., of the southwestern United States. The exact process of formation of the so-called "caliche" (the lime caliche—not the sodium salt caliche of South America), "tepetate," etc., is uncertain, but is probably similar. Under extreme aridity there is on many types of soil practically no final downward movement of water. The entire rainfall is stored in the subsurface layers and returned

to the atmosphere by direct evaporation or through plants. Here there is no leaching of even the most soluble salts. Instead they accumulate at or near the surface, forming the so-called "alkali soils." The same process acting on rocks instead of unconsolidated soils causes the surficial accumulation of manganese, iron, etc., and the formation of the "Schutzrinde" or "desert varnish."

Recent Experiments relating to the Transfer of Gold by Cold Dilute Mineral Waters: W. H. Emmons.

The experiments which form the basis of this paper were made by Mr. A. D. Brokaw at the request of the speaker and by Mr. W. J. McCaughey and others. The experiments show that with cold dilute solutions approximating in composition the average of many mine waters, there is markedly great solvent action on gold when manganese is present. The best available data indicate that such solvent action is more than 250 times as great with solutions of manganitic salts as with solutions of cupric or ferric salts of similar concentration. Conversely, it has also been demonstrated experimentally that the precipitation of gold by ferrous sulphate is delayed if manganitic salts are present in the solutions.

It may be inferred from these experiments (1) that manganiferous gold ores should be more extensively leached of their gold in the upper portions of the lodes than deposits which do not carry manganese, and as a consequence that rich placers would be less likely to be associated with manganiferous than with non-manganiferous gold deposits; (2) that secondary enrichment in gold would extend to greater depths in manganiferous than in non-manganiferous lodes.

Using Lindgren's classification of the gold deposits of North America, a study of the literature was made to determine to what extent these conclusions were supported by field evidence. In general those deposits in which it has been supposed that gold was dissolved and reprecipitated by cold meteoric waters are characterized by manganiferous gangues. Nearly all of these are of late Cretaceous or Tertiary age.

Some Features of the Geology of the Navajo Reservation: H. E. Gregory.

During the field season of 1909 a reconnaissance survey was made of that portion of Arizona and Utah between the Little Colorado and San Juan rivers. The topographic expression of this region is, in general, a plateau with an elevation of about 6,000 feet, reaching 10,400 feet at Navajo Mountain and dropping to 5,000 feet at the north and south where the Cretaceous beds have been removed. With the exception of Chin Lee Valley and the broad washes tributary to the Little Colorado, the stream channels are deeply intrenched. This fact, together with the scarcity of water and the occasional unfriendly attitude of the Navajo and Pahute Indians, makes the country somewhat difficult of access.

The strata in general are horizontal, with the exception of the monocline extending from Comb wash to Marsh Pass, the anticlines cut by the San Juan north of Monument Valley and the Defiance fold with accompanying hogbacks. Rocks of Triassic age are the most widely exposed, but the Carboniferous is seen in the San Juan canyon; the Moencopie (Permian?) covers considerable areas; the Jurassic is believed to be represented; the Cretaceous (Dakota and Colorado?) forms the Zilh-le-jini Mesa, as well as the mountains along the Arizona-New Mexico line; and the Tertiary caps Choiska and possibly also Navajo Mountain. The Moki Buttes south of Keams Canyon consist of necks and lava-capped mesas, remnants of flows of probably post-Pliocene time, which covered an area of approximately 600 square miles. Necks and dikes of Jurassic rock, usually basalt carrying peridote, are scattered irregularly over the reservation. Parts of Tunitcha and Lukachuckai Mountain are capped by lava and the Carriso Mountain is a mass of diorite of laccolithic origin.

The oil field twenty-five miles west of Bluff, Utah, and the coal field at and to the north of the Hopi villages are of commercial importance, but there is little basis for the reports of gold and silver deposits. Preliminary studies of this region indicate that by means of shallow and deep rock wells water may be developed in sufficient quantities to enable the Navajo, Pahute and Hopi Indians to increase the size of their flocks and the number of small fields suitable for the growth of corn.

At the 233d meeting of the society, held on Wednesday, May 11, 1910, the following papers were read:

Regular Program

The Composition of the Soil Solution: F. K. Cameron.

The soil solution is the result of geological processes, and is the natural nutrient medium for

plants. The organic constituents of the solution while important for plants, have only a minor interest for geology, but the inorganic constituents have a great importance for both. The soil solution is a medium for the transport of mineral substances, and the phenomena involved, which have been studied from an agronomic point of view, probably have also an importance in the study of secondary enrichments and similar problems.

Soils are far more heterogeneous than rocks. All the common rock-forming minerals are present in most soils, because of the actions of various mixing agencies, especially transportation by water and wind. These minerals dissolve quickly and are hydrolized by the water. This is the process of weathering. As fast as the hydrolized products are removed, the minerals continue to dissolve. If these were the only considerations, however, we should expect to find the same solution in all soils, under the same conditions of temperature, etc. But disturbing factors enter the problem. Prominent are the specific actions of dissolved carbon dioxide and oxygen. Most important are the phenomena of absorption, which are very marked with most soils. The distribution of a dissolved substance between an absorbent and a solvent is dependent upon the relative quantities present. Therefore the individual physical and chemical peculiarities of a soil will affect the composition of the soil solution. Experimental investigation, however, shows that the differences in the mineral content of soil solutions under similar climatic conditions are always relatively small. A consideration of the disposal of the rainfall in the soil shows that of the portion which enters the soil the greater part returns to the surface, and is of a higher concentration than the seepage waters. Consequently there is a tendency for the dissolved mineral substances to accumulate at or near the surface. This is actually realized in some arid and semi-arid regions. In humid areas, excessive amounts are washed into the drainage or back into the subsoil to again slowly move towards the surface with the capillary waters.

Some Evidences of Recent Subsidence on the New England Coast: CHARLES A. DAVIS.

Localities examined in Maine, New Hampshire, Massachusetts and Connecticut all show subsidence: (1) By the drowned coast characterized by fiords, wide estuaries, valleys extending out to sea and shore lines that have clearly migrated inland in recent times. (2) By the occurrence below tide-level, both inside and outside the present beaches, of submerged roots of trees of existing species, unquestionably in place as they grew. (3) By deposits of fresh-water peat now lying below tide-level and being actively eroded by the sea. (4) By positive engineering record that the masonry sills and floor of the old dry dock at Charlestown Navy-yard in 1903 were 0.71 foot lower relative to mean sea-level than seventy-two years previous, while they stood at exactly the same level in respect to points on solid ground. (5) By the salt marshes which occur wherever the gradient of the coastal region is slight. The structure of these marshes shows that they have been formed: (*a*) By gradual submergence of fresh-water deposits, which may include tree remains. (*b*) By the increase in thickness of the peat formed by the grasses growing on the present surface of the salt marshes, of which *Spartina patens* (Ait.) Muhl. and *Distichlis spicata* (L.) Greene, are by far the most generally distributed and important species.

These grow only in places covered not more than about four hours each day by salt water, *i. e.*, where they are just reached by ordinary high tides, while areas above and below these levels are occupied by entirely different plant species. The two species mentioned form a very characteristic and easily recognizable peat and its occurrence in beds ten or more feet thick, reaching continuously from the present surface of salt marshes to below low-water mark, with possibly fresh-water peat below this, is indisputable evidence that there has been subsidence equivalent in amount to the thickness of the salt-marsh beds, and at a rate exactly equivalent to the rate of upbuilding of the turf formed by the two grasses mentioned; this rate must be generally small.

No evidence has been found indicating that salt marshes lie in depressions, formed by indentations in the shore line which are in process of being cut off by barrier beaches, and which have been filled either by salt- or fresh-water vegetation; the structure of the deposits and the contours of the bottoms of the marshes examined being entirely against such an hypothesis.

Fox Hills Sandstone and "Ceratops Beds" in South Dakota, North Dakota and Eastern Wyoming: T. W. STANTON.

In the area adjacent to the Missouri River in northern South Dakota and southern North Dakota the latest marine Cretaceous formation is

the Fox Hills sandstone which was long ago described in this area by Meek and Hayden, who named it from its typical occurrence in the Fox Hills, which form a ridge between the Cheyenne and Moreau rivers and extend to the Missouri north of the Moreau. It is a shallow-water or littoral deposit of variable character usually not much over 100 feet thick in this area. It yields an abundant invertebrate fauna closely allied to that of the underlying Pierre, but with some distinctive species.

Above the Fox Hills sandstone there is a non-marine formation several hundred feet thick which is correlated with the so-called "Ceratops beds" of Wyoming, as it contains abundant remains of the dinosaur genera Triceratops and Trachodon and other reptiles belonging to the same fauna. It also yields fossil plants which have been identified as belonging to the flora of the "Lower Fort Union," to which horizon the "Ceratops beds" of other areas have also been assigned on the evidence of fossil plants. The Fort Union formation is supposed to be later than the Denver. Hence, if the "Ceratops beds" are Fort Union, where they rest on the Fox Hills there is a break in the sedimentary record which represents the Laramie, Arapahoe and Denver formations. In the examination of the area last summer by Geological Survey parties a somewhat eroded and channeled surface in the upper part of the Fox Hills sandstone was found at many points and was at first interpreted as an important unconformity giving evidence of the break above mentioned. The uneven surface is at the base of brackish-water bed full of shells of *Ostrea*, *Anomia*, *Corbicula*, etc., belonging to the same types and usually specifically identical with forms that occur in the Laramie. In the same bed with the brackish-water shells, and associated in such a way that they must have lived contemporaneously, a number of typical marine species belonging to the Fox Hills fauna were found. These include *Scaphites conradi* (Morton), *Scaphites conradi* var. *intermedius* Meek, *Scaphites cheyennensis* (Owen), *Lunatia subcrassa* M. & H., *Teredo* sp. and *Tancredia americana* M. & H.

This commingling of the marine Fox Hills species with the brackish-water fauna above the eroded surface was found at five localities distributed over an area about forty miles square. It proves that the erosion was geologically contemporaneous with the sedimentation and that the brackish-water bed really belongs to the Fox Hills. The wide-spread occurrence of this brackish-water bed at the top of the marine deposits and the absence of evidence of an unconformity immediately above it give strong evidence that there was a gradual transition from marine to land and fresh-water conditions.

In the southwest part of North Dakota on the Little Missouri, where there is a similar development of Fox Hills sandstone, the change from marine to land conditions is locally abrupt, so that lignitic land deposits rest directly on an uneven surface of the sandstone, but about 500 feet higher in the section there is an oyster bed with Cretaceous species of *Ostrea* indicating that the sea had not left the region until after a large part of the "Ceratops beds" was deposited.

In the Lance Creek area of Converse County, eastern Wyoming, the Fox Hills sandstone develops a thickness of about 500 feet and in its upper part contains thin coal beds and other evidences of land conditions intercalated in marine strata. At the top there is a brackish-water zone followed by the "Ceratops beds." The evidence is in favor of a gradual transition and practically continuous sedimentation rather than a long unrepresented interval.

The three areas discussed tell a story of gradually changing conditions near the end of the Cretaceous when the uplift of the Rocky Mountain region was draining the interior sea. The uplift was neither uniform nor continuous and the emergence above sea level could not have been simultaneous for all localities throughout the region. As the sea became shallow the effect of tidal currents and wave action was shown in irregular deposition, cross-bedding and local erosion, and when an area was elevated above tide the deposits formed were subjected to all the varying conditions of flood plains, deltas and marshes. It would depend on the configuration of the coast, the topography and drainage of the adjacent land and the rate of elevation whether at any particular locality the last marine bed would be covered by a brackish-water deposit or followed immediately by land conditions.

The bearing which the facts here presented have on the Laramie problem is self-evident. If there is a transition with practically continuous sedimentation from the Fox Hills sandstone into the "Ceratops beds" in the region discussed, then these "Ceratops beds" include the Laramie.

Francois E. Matthes,
Secretary